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Assignment

(1) Area of a circle = πr^2

Area calculated = $r = 12.65$

$= \pi \times (12.65)^2 = 502.92785$

Correct value = $r = 12.5$

$= \pi \times (12.5)^2 = 491.071$

i) Absolute error = $|502.92785 - 491.071|$

$= 11.85685$

ii) Relative error = $\frac{11.85685}{491.071} = 0.024144879$

iii) Percentage error = $\frac{11.85685}{491.071} \times 100 = 2.4144\%$

(2)

x	$f(x)$
4.0	0.60206
4.5	0.6532125
5.5	0.7403627
6.0	0.7781513

a) $x = 4$, $x = 6$

x	$f(x)$
4	0.60206
6	0.7781513

$h = 2$

$$u = \frac{x - x_0}{h} = \frac{5-4}{2} = 0.5$$

$$f(x) = f(x_0) + u \, \Delta f(x_0)$$

$$= 0.60206 + \frac{1}{2}(0.7781513 - 0.60206)$$

$$= 0.69010565$$

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b)

x	$f(x)$
4.5	0.6532125
5.5	0.7403627

$h = 1$

$u = \frac{5.5 - 4.5}{2} = \frac{1}{2} = 0.5$

$f(x) = 0.6532125 + \frac{1}{2}(0.7403627 - 0.6532125)$

$= 0.6967876$

3) $x^4 - x - 10 = 0$

x	y
1.5	-6.4375
2	4

$x_3 = \frac{x_1 + x_2}{2} = \frac{1.5+2}{2} = 1.75$

$y_3 = (1.75)^4 - 1.75 - 10 = -2.37109375$

x	y
1.75	-2.37109375
2	4

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$x_4 = \frac{1.75+2}{2} = 1.875$

$y_4 = (1.875)^4 - 1.875 - 10 = 0.484619$

x	y
1.75	-2.37109375
1.875	0.484619

$x_5 = 1.8125$

$y_5 = (1.8125)^4 - 1.8125 - 10 = -1.020248$

x	y
1.8125	-1.020248
1.875	0.484619

$x_6 = 1.84375$

$y_6 = (1.84375)^4 - 1.84375 - 10 = -0.287734$

x	y
1.84375	-0.287735
1.875	0.484619

$x_7 = 1.859375$

$y_7 = 0.093378126$

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4) $f(x) = x^3 - x - 1$

$f'(x) = 3x^2 - 1$

$x_1 = 1$

$f(x) = -1$

$f'(x) = 2$

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)} = 1 - \frac{(-1)}{2} = 1 + \frac{1}{2} = 1.5$$

$f(x_2) = 0.875$

$f'(x_2) = 5.75$

$$x_3 = 1.5 - \frac{0.875}{5.75} = 0.84782$$

$f(x_3) = -1.2384$

$f'(x_3) = 1.1564$

$$x_4 = 0.84782 - \frac{(-1.2384)}{1.1564} = 1.9187$$

$f(x_4) = 4.1448$

$f'(x_4) = 10.044$

$$x_5 = 1.9187 - \frac{4.1448}{10.044} = 1.5060$$

$f(x_5) = 0.9096$

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$f'(x_5) = 5.8041$

$x_6 = 1.5060 - \dfrac{0.9096}{5.8041} = 1.3492$

$f(x_6) = 0.10680$
$f'(x_6) = 4.46102$

$x_7 = 1.3492 - \dfrac{0.10680}{4.46102} = 1.3252$

5) $A^2 = A$

$= 7A - (1+A)^3$
$= 7A - (1^3 + A^3 + 3A^2 1 + 3A1^2)$
$= 7A - 1^3 - A^3 - 3A^2 1 - 3A1^2$
$= 7A - (1 + A^3 + 3A + 3A^2)$

$= 7A - (1 + A^2 \cdot A + 3A + 3A^2)$

$= 7A - (1 + A \cdot A + 3A + 3A)$ $\quad [A^2 = A]$
$= 7A - (1 + A^2 + 6A)$
$= 7A - (1 + 7A)$
$= -I$

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b) $\begin{bmatrix} 1 & -1 & 2 \\ 4 & 0 & 6 \\ 0 & 1 & -1 \end{bmatrix}$

$A^{-1} = \frac{1}{|A|} \times \text{adj } A$

$|A| = 1(0 \times -1 - 6) - (-1)(4 \times -1 - 0 \times 6)$

$+ 2[4 \times 1 - 0]$

$= -6 - 4 + 8 = -2$

adj A = $\cancel{1(0 \times -1 \times -6) = -6}$

$\cancel{-1(4 \times -1 - 0) = 4}$

$\cancel{2(4 \times 1 - 0) =}$

$= a_{11} = (-1 \times 0 - 6) = -6$

$a_{12} = (-1 \times 4 - 0) = -4$

$a_{13} = (4 \times 1) = 4$

$a_{21} = (-1 \times -1 - 2) = 0$

$a_{22} = (1 \times -1 - 0) = -1$

$a_{23} = (1 \times 1 - 0 \times -1) = 1$

$a_{31} = (-1 \times 6 - 0) = -6$

$a_{32} = (1 \times 6 - 8) = -2$

$a_{33} = (1 \times 0 - (-1 \times 4)) = 4$

$\begin{bmatrix} -6 & -4 & 4 \\ 0 & -1 & 1 \\ -6 & -2 & 4 \end{bmatrix} = \begin{bmatrix} -6 & 0 & -6 \\ -4 & -1 & -2 \\ 4 & 1 & 4 \end{bmatrix}$

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$$A^{-1} = \frac{1}{-2}\begin{bmatrix} -6 & 0 & -6 \\ -4 & -1 & -2 \\ 4 & 1 & 4 \end{bmatrix}$$

7) $A = 8\hat{i} - 9\hat{j}$

$B = 7\hat{i} - 9\hat{j}$

$\vec{A}.\vec{B} = (8)(7) + (-9)(-9)$

$= 56 + 81 = 137$

$\vec{a}.\vec{b} = |\vec{a}||\vec{b}|\cos\theta$

$|\vec{a}| = \sqrt{8^2+9^2} = \sqrt{81+64} = \sqrt{145}$

$|\vec{b}| = \sqrt{7^2+9^2} = \sqrt{49+81} = \sqrt{130}$

$137 = \sqrt{145} . \sqrt{130} \cos\theta$

$\cos\theta = \frac{137}{\sqrt{145} . \sqrt{130}}$

9) 101, 104, 107, 111 ... 998

$a = 101$
$d = 3$
$n = ?$

$a_n = a + (n-1)d$
$998 = 101 + (n-1)3$
$\frac{897}{3} = n-1$

$n = 300$

Sum $= \frac{n}{2}[2a + (n-1)d]$

$= \frac{300}{2}[2 \times 101 + (299)3]$

$= 164850$

10) 6th term $= ar^5 = 32$
8th " $= ar^7 = 128$

$r^2 = \frac{128}{32} = 4$

$r = 2$

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11) $(4+3x)^5$

$= {}^5C_0\, 4^5 + {}^5C_1\, 4^4 . (3x)^1 + {}^5C_2\, 4^3 . (3x)^2$

$+ {}^5C_3\, 4^2 . (3x)^3 + {}^5C_4\, 4 . (3x)^4 + {}^5C_5 (3x)^5$

$= 1024 + 5(256)(3x) + (10)(64)(9x^2) + (10)(16)(27x^3)$
$+ (5)(4)(81x^4) + 243x^5$

$= 1024 + 3840x + 5760x^2 + 4320x^3 + 1620x^4 + 243x^5$

$= 243x^5 + 1620x^4 + 4320x^3 + 5760x^2 + 3840x + 1024$

12)

$$\begin{bmatrix} 2 & -3 & 0 \\ 2 & -5 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

$|A| = 2(-15) + 3(6) - 0 = 18 - 30 = -12$

$= A^3 - (a+e+i)A^2 + (M_{11} + M_{22} + M_{33}) A - |A| = 0$

$= \lambda^3 - (2-5+3)A^2 + \left[\begin{vmatrix} -5 & 0 \\ 0 & 3 \end{vmatrix} + \begin{vmatrix} 2 & 0 \\ 0 & 3 \end{vmatrix} + \begin{vmatrix} 2 & -3 \\ 2 & -5 \end{vmatrix} \right.$

$- (2(-15) + 3(6) + 0) = 0$

$$\lambda^3 + (-15+6-4)\lambda - (-12) = 0$$

$$\lambda^3 - 14\lambda + 12 = 0$$

13)

$$f(x) = x^3 - 7x^2 + 8x - 3 \quad \text{if } x_0 = 5$$

$$f'(x) = 3x^2 - 14x + 8$$

$$x_0 = 5$$

$$f(x_0) = -13$$

$$f'(x_0) = 13$$

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

$$= 5 - \frac{(-13)}{13} = 5+1 = 6$$

$$x_1 = 6$$

$$f(x_1) = 9$$

$$f'(x_1) = 32$$

$$x_2 = 6 - \frac{(9)}{32} = \underline{5.71875}$$

14) $(1-x+x^2)^4$

$= {}^4C_0\,(1-x)^4 + {}^4C_1\,(1-x)^3 \cdot (x^2) + {}^4C_2\,(1-x)^2 \cdot (x^2)^2$

$+ {}^4C_3\,(1-x) \cdot (x^2)^3 + {}^4C_4\,(x^2)^4$

$= (1-x)^4 + 4(1-x)^3 x^2 + 6x^4(1-x)^2 + 4x^6(1-x) + x^8$

15) $e^{-x} = 3\log x$

$e^{-x} - 3\log x = 0$

x	y
1	0.3678
2	-0.7677

$x_3 = \frac{1+2}{2} = 1.5$

$y_3 = e^{-1.5} - 3\log(1.5) = 0.223130 - \cancel{1.216395327}\ 0.528273777$

$= -0.305143777$

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x	y
1	0.3678
1.5	-0.305143777

$x_4 = \frac{1+1.5}{2} = 1.25$

$y_4 = -0.004225$

x	y
1	0.3678
1.25	-0.004225

$x_5 = \frac{1+1.25}{2} = 1.125$

$y_5 = 0.17119$

x	y
1.125	0.17119
1.25	-0.004225

$x_6 = \frac{1.125+1.25}{2} = 1.1875$

$y_6 = 0.08108$

x	y
1.1875	0.08108
1.25	-0.004225

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$$x_7 = \frac{1.1875 + 1.25}{2} = 1.21875$$

$$y_7 = e^{-1.21875} - 3\log(-1.21875) =$$

$$= 0.038659$$